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ABSTRACT

During the next two decades, vocational education will face a major challenge to keep up to date with technology. National crises usually lead to new technologies. The United States today faces major problems in the areas of energy, productivity, and foreign trade. Solutions to these problems will generate new knowledge and technology that will change skill requirements for many jobs and create many more new ones. Methods that can be used to identify the emerging skills that will be needed include the following: use of advisory committees, creative insight, the DACUM process ("Developing a Curriculum"), the Delphi process, evaluation studies, industrial work experience, labor market surveys, conferences, and task analysis. In order for vocational education to keep pace with changes in technology, it must become more proactive and involved with the transfer of new technology from research and development laboratories to practical use in business and industry. Vocational education curriculum development processes must become more flexible and assist vocational educators in using a variety of data for making curriculum and instructional decisions.
(Author/KC)

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Information Series No. 234

EMERGING SKILLS

Implications for Voc Ed

written by

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and

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U.S. DEPARTMENT OF EDUCATION
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FOREWORD

Emerging Skills: Implications for Voc Ed reviews relevant techniques for identifying emerging skills and suggests appropriate applications for those techniques. The authors' recommendations include the development of a combination of proactive and reactive processes for identifying and making decisions on content for vocational education programs.

This paper is one of seven interpretive papers produced during the fourth year of the National Center's knowledge transformation program. The review and synthesis in each topic area is intended to communicate knowledge and suggest applications. Papers in the series should be of interest to all vocational educators including teachers, administrators, federal agency personnel, researchers, and the National Center staff.

The profession is indebted to Dr. Orville Nelson and Dr. Harold Halfin for their scholarship in preparing this paper. Ronald McCage of V-TECS, Dr. Dan Jarosik of the Wisconsin Advisory Council on Vocational Education, and Dr. Linda Lotto of the National Center for Research in Vocational Education contributed to the development of the paper through their critical review of the manuscript. Staff on the project included Alta Moser, Shelley Grieve, Raymond E. Harlan, Dr. Carol Kowle, Dr. Judith Samuelson, and Dr. Jay Smink. Editorial assistance was provided by Brenda Sessley of the Field Services staff.

Robert E. Taylor
Executive Director
The National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

During the next two decades, vocational education will face a major challenge to keep up to date with technology. National crises usually lead to new technologies. The United States today faces major problems in the areas of energy, productivity, and foreign trade. Solutions to these problems will generate new knowledge and technology that will change skill requirements for many jobs and create many more new ones.

In order for vocational education to keep pace with changes in technology, it must become more proactive and involved with the transfer of new technology from R&D laboratories to practical use in business and industry. Vocational education curriculum development processes must become more flexible and assist vocational educators in using a variety of data for making curriculum and instructional decisions.

INTRODUCTION

The purpose of this paper is to illuminate some of those emerging skills that apparently have immediate importance for vocational education and to provide a summary of some procedures for identifying them. Since today's emerging skills may be obsolete tomorrow, emphasis must be placed on identifying situationally and temporally transferable processes to use to identify new skills. A summary of trends predicted by business and industry is included because vocational education draws much of its skill and knowledge content from this source.

Providing education and training consistent with business and industry practices is a major challenge for vocational education. In the opinion of some, vocational educators have not adequately met this challenge and may be criticized for teaching obsolete skills. Maeroff (1979) reported in *The New York Times* that the effectiveness of vocational education has been challenged by several studies.

In light of the mission of vocational education, it is not unreasonable to expect that keeping current with business and industry technology will be an ongoing problem. Vocational education must keep abreast of the skills and knowledge required for occupations in business and industry. This is, then, a responsive role and it presents the challenge of staying current.

The Vocational Education Amendments of 1968 and 1976 recognized the importance of emerging skills and occupations. These amendments authorized the expenditure of funds to identify and develop curricula for new and emerging occupations. Increased emphasis on advisory committees in this legislation reflected a concern with keeping vocational education programs relevant.

When the content of jobs changed slowly, little need existed for retraining workers. In recent decades, new technology has developed at an exponential rate. For example, 80 percent of the products that the Sperry Rand Corporation will market in 1983 were not on the market in 1978 (*Report of the 1978 Annual Meeting of Stockholders* 1978). As a result of changes such as this, the content of jobs has been modified tremendously. It is estimated that today's worker will need to be retrained eight or nine times before retiring.

This rapid rate of technological change has created significant problems for vocational education curriculum development. It is more difficult to keep the content of vocational education programs current with the needs of business and industry. Because the process required to develop or modify vocational education curricula is lengthy, curricula may be partially obsolete by the time they are approved and put into practice.

It is apparent that vocational education must become more responsive to changes in technology in business and industry if it is to remain relevant. Processes for monitoring new and emerging skills must be refined. The procedures for modifying existing programs and developing new ones must be streamlined and made more efficient. Factors that encourage staff inertia must also be overcome.

New technology is typically developed in response to significant problems or opportunities. At the present time, the United States is faced with a number of significant challenges. A review of these suggests that dramatic changes will take place in business and industry during the coming decade. Some challenges now facing the United States follow.

- American worker productivity must be improved significantly during this decade if United States business and industry are to remain competitive internationally.
- Increased productivity is needed to aid in reducing the present high rate of inflation in the United States.
- More efficient use must be made of energy and resources. Increasing demands on the available supply of energy and natural resources make it imperative that they be utilized more effectively.
- In order for the United States to maintain its technological leadership, greater investments in research are necessary. New technology is essential if the United States is going to compete in the international marketplace.
- The 1980 census reports that the median age of United States citizens has increased from twenty-eight years in 1970 to thirty years in 1980. Due to a significant reduction in the birthrate and improvements in nutrition and health care, the percentage of citizens over sixty-five is increasing rapidly. These population changes are creating demands for health care and other services for older Americans.
- American business and industry have found that they must be more responsive to consumer demands. Japanese businesses have provided an example of how to enter markets successfully by careful market analysis.

The sheer magnitude of the problems related to productivity, energy supplies, and international competition suggests that dramatic changes must be made by business and industry. Signs of these changes are becoming apparent. The American automobile industry began redesigning cars four years ago and has been building new, automated production facilities for the last two years. Industrial robots are being utilized in these new facilities.

Innovations are apparent in energy utilization. Processes that more effectively use fuels are being developed. A variety of conservation measures are being employed by United States' industries.

New technology that results from the solution of major problems is usually applied in many ways. The sophisticated United States space technology of the 1960s has been utilized in a variety of consumer products. New technology developed to solve productivity and energy problems will also find wide application.

Clearly, vocational education faces a continuing challenge in keeping current with the technology developed and used by business and industry. Vocational education attempts to meet this challenge by quickly revising existing programs. Vocational educators also must continually develop new programs to prepare people for a changing labor market. As the American population becomes older, the retraining of adults will become increasingly important.

NEW TECHNOLOGIES

During World War II, materiel, flight, medical, information, and energy technologies were significantly improved. Speed and range of aircraft were greatly expanded. Plastics and other synthetic materials were developed. A number of new drugs and medical practices were created. Atomic and nuclear energy applications were developed. Electronics became sophisticated and the computer age began. These technological developments have had impacts on a wide variety of products, services, and jobs in the past three decades.

When the Soviet Union launched Sputnik I in 1957, the United States' leadership in science and technology was challenged. The United States quickly established a national goal to place an astronaut on the moon. This challenge resulted in dramatic changes in electronics, computing, and communications systems.

The effects of these new technologies are now a part of the everyday lives of all Americans. For example, computers are being applied to a wider variety of jobs and tasks in business and industry. Smaller computers and micro-processors are finding their way into intelligent machines (for example, computer-controlled robots), schools, and homes at an ever increasing rate.

The United States has become aware in recent decades of the need to be concerned with energy supplies. Decreasing domestic fuel production and increasing demands on energy have made this country vulnerable to constraints imposed by energy-exporting nations. As a result, a concerted effort has been mounted to modify existing technologies and develop new ones that are more energy efficient. New techniques and equipment are being designed to locate and to mine energy resources that have previously gone unexplored. In addition, a search for new forms of energy resources and efforts to create the technologies required to convert them into useful energy have begun.

If the development of new technology is truly influenced by the magnitude of the challenges and problems facing our country, the 1980s should be a decade characterized by the birth of a variety of new technologies. The scope and depth of problems facing the United States are sufficiently great to command the development of more sophisticated technology.

The use of automation in business and industry will undoubtedly increase. New tools, equipment, and facilities are being purchased (Sloan and Miles 1980). Many manufacturing concerns are buying or considering buying robots (Flax 1980). In fact, the demand for robots has increased so rapidly that it has been impossible for machine tool manufacturers to keep pace with orders for them ("Robots Join the Labor Force" 1980).

Computers are also being applied to a wide variety of tasks in business and industry. Microprocessors are usually an important component of robots. Computer-assisted design systems are significantly increasing the productivity of designers and engineers. Computers quickly generate a variety of modifications of each design and provide data on each of the modifications.

In manufacturing, computers assist in scheduling activities, maintaining appropriate inventories, and controlling various other critical processes. When computer-assisted design and computer-assisted manufacturing are linked together, even greater efficiencies may be achieved. Information from the design phase can be translated into information that can be directly used in the computer-assisted manufacturing systems. For example, it is now possible to translate shoe designs from a computer-assisted design system into patterns that are stored in another computer and used to cut the materials for shoes.

Several writers and scholars (Drucker 1981, Toffler 1980, and Molitor 1981) have suggested that our society and economy are moving into the "Information Age." Signs of the change to an information-based society can be seen in a variety of jobs. Word processing systems are being combined with computers to merge the capabilities of word and data processing. Increasing volumes of information are being stored, retrieved, and transmitted electronically. The "paperless" office is now a possibility.

New communications systems that allow one to communicate quickly and effectively throughout the world are now available. Large data banks and libraries can be accessed by computer. Information can be quickly retrieved and stored on-line for further analysis and use.

Biotechnology has recently attracted significant attention. Some useful products have been produced by genetic engineering. Plants with enhanced nitrogen assimilation (Brill 1981) and new forms of proteins generated by bacteria (Rose 1981) are two examples. The major impacts of this technology are yet to be assessed.

HUMAN RESOURCES

A growing awareness has been developing that management styles and the roles of employees in American business and industry need to change (Flint 1981). In recent years, the growth rate for productivity of the United States work force was lower than that of almost all of the eleven major industrialized nations (Malkiel 1979).

Economists and management theorists have concluded that the type of management style used in business and industry may be one of the causes of lagging productivity. They suggest that management has focused on short-term solutions to long-range problems and has attempted to make jobs more specialized at the expense of human considerations.

Experiments with modified work environments and new roles for employees have proven to have a positive effect on productivity (Hinrichs 1978). Workers in some organizations are being given more opportunity for participation in decision making related to the tasks they perform. For example, General Motors has successfully involved workers in the design of facilities, tooling, and tasks (Guest 1979). Several companies have initiated systems to improve the quality of work life for employees.

The image of training and development in business and industry has improved significantly during the past three decades (Varney 1981). The training function has recently been moved to the managerial level of many organizations. According to Varney, membership in the American Society of Training and Development has almost tripled in size during the last ten years.

A number of private and professional organizations have established training programs that are offered on a fee basis in major cities throughout the United States. Drucker (1981) has predicted that continuing technical and professional education for adults will be a growing industry in the coming decade.

There is considerable agreement in the literature on the types of competencies required for new technologies. Some of those listed are the ability to do the following:

- Solve problems
- Gather and use data in making decisions
- Interact with and use a computer to do one's work
- Change with the development of new technologies
- Communicate effectively with a variety of persons
- Use new communications systems

- Be self-directed and manage one's own time
- Use information from several disciplines in carrying out one's work
- Understand United States and world economic systems and how an enterprise functions within them

IDENTIFYING EMERGING SKILLS

A variety of curriculum development projects, research reports, and journal articles reveal strategies and processes that are being used to identify emerging skills. Some of these techniques are described below along with examples of their applications. (A listing of studies showing the new skills and trends identified appears in the Appendix.)

Advisory Committee

Vocational education advisory committees are comprised of representatives of business, industry, and labor. One of the major functions of advisory committees is the identification of relevant content for vocational programs (Burt 1987). Vocational education advisory committees can also identify emerging skills, especially if members are involved with the latest technology in their fields. Vocational educators must ensure that consideration of emerging skills is included on their meeting agenda.

Vocational education advisory committee members believe that they have influenced vocational program content, according to a statewide evaluation of secondary vocational programs in Wisconsin (Dale et al. 1980). At the postsecondary level, Sorensen (1974) found that state directors, vocational educators, and advisory committee members think that one of the most important roles of advisory committees is to identify program content.

Creative Insight

The use of creative insight and analysis to identify emerging skills is not well documented. Some information on this approach is available from vocational educators who are in the process of introducing new skill training for existing curricula or developing curricula related to emerging technologies. The identification of emerging skills or occupations usually begins with the acquisition of information on new research developments, processes, or technology through reading professional journals, participation in professional organizations related to the technology, or attendance at conferences or workshops where the new technology is discussed.

DACUM Process

The DACUM curriculum development process was developed in Canada (Sinnett 1976). DACUM stands for "Developing a Curriculum." The process was designed to develop relevant vocational education curricula.

In the DACUM process, identification of the tasks and competencies required to perform a given job is accomplished by a panel of persons who are employed in the job, or who supervise those who are. These people meet with a DACUM facilitator to identify the functions or duties involved in performing the job. Specific tasks related to each function are then identified and

sequenced on logical, psychological, or need bases. The originators of the DACUM process recommended that sequencing of tasks be based on the question, "What do people need to do as they enter the job?" The end product of the DACUM process is a chart that contains all the functions and tasks required to do a certain job, placed in an appropriate sequence, with the competency level needed for each task identified.

Morton (1977) has indicated that the brainstorming atmosphere of the DACUM process stimulates the identification of emerging skills. The experience and knowledge of the panel members, of course, determine the types of tasks identified, so the inclusion of panel members who are working with new technology is important for the identification of emerging skills.

Delphi Process

A review of the literature indicates that the Delphi process has been successfully used to identify new and emerging skills. This process was developed after World War II to provide a means for projecting trends related to military and international affairs. It has subsequently been applied to a variety of problems in education, business, and industry.

A Delphi study involves a panel of experts in a series of surveys. The panel is composed of persons who are knowledgeable about all or parts of the selected problem. Input from the panel is solicited by mail survey. This reduces the effect of personal interactions on the decisions of panel members.

In the first round, a list of trends or events related to the problem is obtained from the panel through general questions. The responses to this survey are synthesized and a rating scale is developed. The respondents are then, in the second round, asked to indicate the likelihood of occurrence, importance, and/or impact of the trends listed. Responses are summarized, and the area of consensus for each item is determined.

In the third round, Delphi panel members whose responses are not within the consensus area for an item are asked to modify or to write a justification for those responses. The ratings and comments obtained in the third round are summarized and returned to the panel. In the fourth round, the panel members are asked either to modify responses that are outside the area of consensus or to write a counterargument to the responses that are at the other extreme of the response continuum.

The Delphi process elicits a wide variety of ideas and projections. It helps to derive consensus on most of the trends or items listed, but it also provides an opportunity for input that is not consistent with the majority of the members of the group. The arguments and counterarguments often provide information about new trends and directions.

The Delphi process proved to be valuable in forecasting trends and events related to vocational education in Wisconsin (Arora 1974). Changes in a variety of areas, such as communications, demographics, manufacturing, agriculture, and transportation were predicted. For example, trends toward small cars, home computers, and automated manufacturing were forecast. The accuracy of those predictions is now apparent.

Evaluation Study

Since evaluation or follow-up studies typically involve vocational education graduates and their employers, they provide an excellent opportunity to acquire feedback on emerging skills.

Although specific questions on emerging skills were not asked, evaluation reports from Oklahoma (Morton et al. 1977) and Wisconsin (Dale et al. 1980) suggest that vocational education programs in those states are, in general, keeping current with business and industry technology.

Industrial Work Experience

The importance of experience in business and industry for vocational educators is emphasized throughout vocational education literature (Elliott 1978). Work experience is often a requirement for certification of vocational educators. Many vocational education teachers have not had a recent opportunity to return to the occupation that they represent and have therefore not been able to remain current with technology through this means.

Programs have been established by some states and school systems to assist vocational educators in renewing their work experience. Teachers who have participated in programs that give them experience in business and industry indicate that these experiences are helpful in identifying new technology and the skills required to utilize it.

Another way, then, to identify emerging skills and incorporate related training in vocational education programs is to employ teachers who recently have been using skills related to new technologies. This approach is most feasible for expanding or new programs.

Labor Market Survey

Labor market surveys are conducted at national, regional, state, and local levels. The U.S. Department of Labor provides frequent reports of trends in the labor market. State departments responsible for industry and labor affairs also conduct labor market surveys. Some local labor market surveys are conducted by local government agencies or by schools.

Labor market surveys identify the number of available jobs in specific job categories. Because the purpose of labor market surveys is to report employment trends, the information obtained is concerned only with jobs. Emerging skills are therefore not identified. In some surveys, however, emerging occupations are identified. These data can be useful to vocational program planners.

Examples of surveys that have identified emerging occupations include one completed by the state of Washington. This labor market study identified several emerging occupations (Halverson et al. 1978). A survey of data processing jobs in Pennsylvania identified some skill areas that vocational educators should emphasize (Cannon, Armstrong, and Armstrong 1978).

In addition, a modified labor market survey was completed in Pennsylvania by John Shuman* of the Lehigh Valley Manpower Area in which information on new technology and processes was gathered rather than the usual data on retirements, turnover, and new positions. This information was collected through interviews with employees who were knowledgeable about the new technology and its implications.

* Telephone interview, June 2, 1981.

Study, Survey, or Conference

These activities usually involve bringing together or acquiring input from a panel of experts selected on a regional or national basis. Participants are normally chosen from a variety of fields. For example, the Wingspread Conference (*Changing Workforce Needs With Implications for Higher Education* 1978) brought together individuals from business, industry, vocational education, and higher education to discuss the impacts of changing lifestyles, demography, and technology on the skills required of workers.

The New York State Department of Education established a "Futurizing Committee" to review its business education curriculum and make recommendations for change (Wakin 1981). The committee recommended that vocational educators place more emphasis on problem solving, decision making, and human relations skills. Computer literacy was recognized as an important educational goal. The need for a better understanding by students of the United States economic system was emphasized. This study was seen as so effective that the process is to be utilized for all vocational education programs in New York (Freeborne 1981).

Hogue (1979) surveyed business people and distributive education coordinators in an attempt to identify emerging occupations. Two of the identified emerging jobs were related to international travel and commerce. Skills related to international transactions are apparently becoming more important.

Participants from agriculture, industry, labor, and government, in a symposium on the role of vocational education in the United States' economy, noted a variety of problems in forecasting (Van Ausdle 1978). Several participants suggested that forecasting must be a continuous process.

Task Analysis

Task analysis is the procedure most commonly used in vocational education for identifying the skills needed to perform a job. A task is a job component which is comprised of a set of related activities. Task analysis is a process in which the tasks commonly performed by people in a specific job or set of related jobs are identified and verified.

Tasks are verified by submitting descriptions of them to persons who perform that job and to their supervisors. These persons rate the tasks according to importance and/or frequency of use. This information may then be used by curriculum developers to plan training strategies for those tasks that should be included in related vocational education programs.

Task analysis may be completed through observation, interview, or mail survey. It provides a snapshot of the tasks performed on a job at a given point in time (Johnson 1977). Because of the nature of the task analysis process, emerging skills are usually not identified. In order to do this, task analyses would have to be conducted continually and trend predictions related to the utilization of the tasks over a period of time would have to be established.

An apparently promising approach is to survey respondents to predict the importance of selected tasks during the ensuing five years (Lesch 1975). According to Gerald Lesch,** such projections have proved to be accurate and useful in modifying curricula.

** Telephone interview, June 6, 1981.

ADOPTION OF INNOVATIONS

Based on descriptions of product development, there appear to be seven phases in the adoption and utilization of a given product or practice. These phases are (1) applied research, (2) early transfer, (3) transfer, (4) early adoption, (5) general adoption, (6) stable usage, and (7) decline. Each of these stages is described briefly below.

Applied Research Phase

In the applied research phase of innovation adoption, the products of basic research are being investigated and applied to one or more problems in business or industry. Specific user applications are being developed. The new technology is being utilized in few businesses or industries except on an experimental basis. Information on the new technology is available through technical journals, conferences, and persons who work with the technology.

Early Transfer Phase

In the early transfer phase, specific business and industry applications have been developed, and some businesses and industries are testing or using these applications. In most instances, these applications are found in firms that use state-of-the-art technology. In this phase, more people will have experience with the technology. It will be easier to acquire advisory committee members who have experience or knowledge of the technology. Also, vendor-sponsored technical training sessions may be available. Information on the technology and potential spin-offs will be more widely available through a greater variety of conferences, reports, and journals.

Transfer Phase

In the transfer phase, many businesses and industries that have direct applications of the new technology will be using or experimenting with it. There will be more people available who are knowledgeable about the new technology and its implications for vocational training. In addition, better data will be available for establishing trends in the application and use of the new technology.

Early Adoption Phase

In the early adoption phase, many of the businesses and industries in which the new technology has applications are either using, experimenting with, or planning to introduce it into their operations. Some secondary or spin-off applications are also starting to appear. A number of employees and supervisors who have experience with the technology will be available to participate in activities designed to gather information about emerging skills.

General Adoption Phase

In the general adoption phase, most businesses and industries with direct applications of the new technology have adopted or are considering it. In addition, the number of spin-offs and secondary and tertiary applications is growing. The spin-offs may be growing dramatically if the technology is applicable to a wide variety of products and services. For example, laser and integrated circuit technologies are presently being utilized in a wide variety of applications. At this point, the type and number of jobs associated with the technology can be defined with some accuracy.

Stable Use Phase

By the time the stable use phase arrives, the technology has been adopted by most, if not all, of the businesses and industries that can use it. The processes, skills, and attitudes associated with the technology are well defined and readily available to curriculum developers. A main concern in this phase is preparing people who have adequate skill levels to perform rather well-defined jobs. Another concern is related to the length of time the technology will remain in a stable form. There is a need to continue to monitor developments in the technology and in competing technologies.

Declining Use Phase

In the declining use phase, the technology has outlived its general usefulness. New technologies have been developed to compete with it and to take its place. The number of jobs based on the technology is declining, and the tasks and skills based on it are being replaced by new skills. The emerging technologies will need to be studied and their implications for vocational education programs identified.

Effectiveness of Techniques

The techniques suggested for use in identifying emerging skills are more effectively employed at some phases in the acceptance and application of innovations than at others. The available sources of information on new skills vary with the degree to which new technology has been transferred from the research phase to the adoption phase. The relative usefulness of each technique during each phase of the transfer and use process is indicated in table 1.

Further, these techniques have relative advantages and disadvantages for implementation in general and for the identification of emerging skills, in particular. These relative advantages and disadvantages are displayed in table 2.

TABLE 1

RELATIVE EFFECTIVENESS OF TECHNIQUES FOR IDENTIFYING EMERGING SKILLS AT EACH PHASE OF THE ADOPTION AND USE OF INNOVATIONS

Technique	*PHASE I	II	III	IV	V	VI	VII
Advisory Committee	2	2	2	1	1	1	1
Creative Insight	1	1	1	2	3	3	1
DACUM Process	0	2	2	1	1	1	0
Delphi Process	1	1	1	3	3	3	1
Evaluation Study	0	3	3	2	2	2	2
Industrial Work Experience	0	0	2	2	1	1	2
Labor Market Survey	0	0	0	3	3	3	3
Study, Survey, or Conference	3	2	2	3	3	3	3
Task Analysis	0	0	3	2	1	1	0

RELATIVE EFFECTIVENESS

Extremely Useful (1)
Useful (2)
Somewhat Useful (3)
Not Applicable (0)

*PHASE

I – Applied Research
II – Early Transfer
III – Transfer
IV – Early Adoption
V – General Adoption
VI – Stable Use
VII – Declining Use

TABLE 2

TECHNIQUES USEFUL FOR IDENTIFYING EMERGING SKILLS: ADVANTAGES AND DISADVANTAGES

ADVISORY COMMITTEE

Advantages	*Disadvantages*
Provides information directly from local business, industry, and labor.	Information available from local business and industry may not include state-of-the-art technology.
Provides opportunities for obtaining information from state-of-the-art business and industry.	

CREATIVE INSIGHT

Advantages	*Disadvantages*
Provides flexible opportunities for vocational educators to participate.	Difficult to coordinate and to document.
Provides maximum potential for immediate application of information gained in vocational education classrooms.	Requires continuing leadership of local administrator.
	Requires funding support for optimum effectiveness (workshops, conferences, and so forth).

DACUM PROCESS

Advantages	*Disadvantages*
Provides information about current business and industry technology.	Information available from local business and industry may not include state-of-the-art technology.
Produces high quality information.	Provides information about emerging skills only if specifically designed to do so.
Requires a minimum of time.	
Provides an opportunity to obtain information on competencies related to emerging skills.	

DELPHI PROCESS

Advantages	*Disadvantages*
Provides opportunities to obtain forecasts from experts representative of all geographical regions.	Requires the commitment of an extended time period by participants (some may not complete the process).
Produces high quality information.	Requires a considerable amount of staff time.

TABLE 2 (continued)

EVALUATION STUDY

Advantages	*Disadvantages*
Provides information about changing needs for skills.	Provides information about emerging skills only if specifically designed to do so.
Provides a means for easy and continuous collection of data.	

INDUSTRIAL WORK EXPERIENCE

Advantages	*Disadvantages*
Provides opportunities to obtain state-of-the-art knowledge and skills.	Availability of jobs may be limited.
Provides information about current business and industry concerns.	Available jobs may not provide state-of-the-art experiences.

LABOR MARKET SURVEY

Advantages	*Disadvantages*
Provides data on the composition of the existing labor market.	Information provided is influenced by economic cycles (during economic slowdowns job openings are underestimated).
Provides information on the projected job openings in each job category.	Identifies few emerging skills.
Provides information on recent trends in the labor market (when the data from a series of surveys are analyzed).	

STUDY, SURVEY, OR CONFERENCE

Advantages	*Disadvantages*
Provides opportunities to obtain information on a specific trend.	Requires that expert participants be available.
Provides opportunities to obtain information from experts.	Requires considerable expenditures.
Produces high quality information.	Requires a considerable amount of time and effort to organize, conduct, and report.
	Dissemination of reported information may be limited.

TABLE 2 (continued)

TASK ANALYSIS

Advantages	*Disadvantages*
Identifies skills required for established jobs.	Provides information only about skills required at the time of the analysis.
Provides information understood by most vocational educators.	Requires a considerable amount of time to complete.
Provides useful information for curriculum development.	Identifies few emerging skills.
Provides meaningful information to business and industry.	Identifies technical skills only.

IDENTIFYING EMERGING OCCUPATIONS

The first research completed on the development of vocational programs for new and emerging occupations is apparently that of Meleen et al. (1976). This project focused on emerging occupations at the national level and concluded that social and technological changes are the major factors that lead to new and emerging occupations.

Steps listed for utilization in the process of identifying emerging occupations are as follows:

1. Identify social and technological changes that have potential for generating new occupations.

2. Review occupational data and labor market forecasts to identify specific occupational areas and job titles that merit further study.

3. Develop projections of the growth rate of the new occupations.

4. Collect additional information on these occupations through interviews with employers and other persons knowledgeable about trends and associated emerging occupations.

The Meleen study found that there is no apparent employment data base that provides information on new and emerging occupations. Existing data bases were constructed to provide information on current jobs, job openings, and employment trends related to them. There is, therefore, no information available on emerging occupations from these sources.

Because existing occupational labor market data bases do not provide sufficient information on growth projections for new and emerging occupations, additional methods have been developed for generating these projections. Meleen suggests that analysis of employment statistics for related occupations, legislative trends, production and sales growth rates, and investment patterns may provide information on emerging occupations.

Additional information on emerging occupations may be obtained through interviews with people who are knowledgeable about the changes that produce a new occupation. Information from such persons can be used along with labor market projections to infer competencies needed in vocational education programs.

This process was used by Meleen in both 1975 and 1976 to identify the following new and emerging occupations.

- Child advocate
- Energy efficiency technician
- Halfway house resident manager

- Horticultural therapy aide
- Industrial hygiene technician
- Nuclear quality assurance inspector
- Physical security technician
- Podiatric assistant
- Crystal manufacturing worker
- Housing rehabilitation specialist
- Public safety communications operator

A West Virginia Department of Education project designated five areas in which emerging jobs were to be identified. These areas were (1) energy production, distribution, and uses; (2) public service; (3) health-related services; (4) manufacturing technology; and (5) tourism and recreation. A system for identifying emerging occupations based on a combination of labor market demand statistics and advice from a panel of experts was developed for this purpose by Associated Educational Consultants (*Identification of New and Emerging Careers or Occupations in West Virginia and Determination of the Feasibility of Providing Vocational Education Programs* 1979).

Project staff members worked with a task force to develop a survey form to be used in identifying (1) new occupations, (2) those that had recently undergone major changes, and (3) those in which future changes were anticipated. The survey was sent to representatives of West Virginia business and industry who were also given the opportunity to identify additional emerging occupations.

Project staff created guidelines for developing new curricula and for monitoring the relevance of existing curricula. These procedures recommend the use of student, labor market, industry, and demographic data in developing new vocational education programs and monitoring the content of existing ones.

A handbook on emerging occupations that was developed for the state of California emphasizes a flexible and varied approach to identifying emerging occupations (Maxwell and West 1980). It suggests that the most important factor in identifying new and emerging occupations is an effective communications system. Such a system would involve individuals in business, industry, and education who are knowledgeable about trends that have potential for influencing the development of new and emerging occupations.

The handbook utilizes the process developed by Nelson (1980) for monitoring factors involved in stimulating the development of new occupations. The criteria utilized in the handbook for judging whether an occupation fits the category of "new and emerging" are similar to those suggested by Meleen. These criteria are as follows:

1. The occupation has been in existence approximately (and not more than) ten years.
2. The occupation must require at least six months of training.

3. A shortage of workers in the occupation must be anticipated.

The Nelson study presented a system for predicting emerging occupations that is based upon monitoring trends in demographics, technology, legislation, resources, and life-styles. The involvement of vocational education teachers, researchers, and administrators in the process of monitoring these trends using triangulation of data—gathering multiple sets of information drawn from different sources—was suggested. Some low risk options for introducing related instruction into vocational education programs were identified. These options include workshops, short courses, regular courses, and units within courses.

A SYSTEM FOR IDENTIFYING EMERGING SKILLS

Stuart (1972) developed a process to identify new skills in selected occupations for the state of Michigan. The process was based on a task analysis approach to the identification of curriculum content. Detroit, Grand Rapids, and Mt. Pleasant were selected as pilot-test sites.

A task analysis technique was utilized with employers to identify the entry-level skills required in selected occupations and the level of competence of vocational education graduates in these skills. Task lists developed by project staff for each of the occupations were submitted to first-line supervisors who identified job skills. Personnel managers identified job-seeking and personal/social skills required.

Related vocational education programs were then reviewed to identify the skills being developed, and senior students indicated their level of competence in those skills. The discrepancies between required and obtained skill levels were then assessed. These discrepancies formed the basis for recommendations for changes in vocational education programs. The study revealed the need for the inclusion of a number of new skills in vocational education programs.

Some of the systems created to identify emerging occupations could be modified for use in assessing the relevance of emerging skills. Some of the approaches used in specific research and curriculum development projects are applicable to the design of a system for locating emerging skills.

Based on a review and synthesis of available information, it appears that an effective system for monitoring emerging skills is characterized by the following:

- The utilization of a variety of data.
- The involvement of vocational educators.
- The utilization of information from outside vocational education (data from R&D labs, business, industry, and government).
- Incentives for vocational educators to monitor the basic and applied research and new technical developments related to their fields.
- Continuous data collection, analysis, and forecasting. (The vocational education curriculum development system must have the capacity for processing large volumes of data.)
- Techniques for developing descriptions of future events, such as the Delphi process.
- The provision of information that vocational educators can and will use.

IMPLICATIONS FOR VOCATIONAL EDUCATION

It is critical that vocational education utilize curriculum development procedures that are flexible, efficient, and responsive to emerging skills. New vocational education programs will have to be developed to train students for existing jobs in which the level of skill has escalated. Programs will also be needed to train students for new occupations that emerge. In addition, it will be necessary to retrain a large number of persons who are already employed, some of them for new jobs.

Changing Philosophy

The key to making vocational education more responsive to emerging skills may be to change the philosophy on which vocational education is based. Vocational education programs and curricula have been based on what workers presently do in their jobs. Emphasis has been placed on identifying present practices and transmitting these to persons enrolled in vocational education programs.

This process is effective when the knowledge and skill content of jobs is relatively stable. However, when the content of jobs is changing, the process allows the content of vocational education programs to lag behind that of jobs related to them. In addition, it does not encourage vocational education to become involved in aiding business and industry to make the transition to new technology.

Basic questions vocational educators must consider are these:

1. Should vocational education remain primarily reactive to the needs of business and industry relative to knowledge and skill content of jobs? Perhaps vocational education should develop an approach that has an appropriate combination of proactive and reactive processes for identifying and making decisions on content for vocational education programs.

2. Does vocational education have responsibility only for transmitting existing occupational skills and knowledge? Perhaps vocational education should also be involved in creating and refining new skills.

3. Is the responsibility of vocational education limited to working with current technology only? Perhaps vocational education has the responsibility to translate research results into new technology.

4. Should vocational education programs be designed to prepare people only for currently available jobs or clusters of jobs? Perhaps vocational education should also be responsible for developing skills that will facilitate transition into new jobs as technology changes or as individual aspirations and needs change.

Curriculum Development

Research and curriculum projects generally use the task analysis approach for identifying vocational education program content. Many also use labor market surveys. These methods illuminate the skills, knowledge, and attitudes required in a job at the time the analyses are completed and provide an estimate of the available job openings. Some of these systems for developing and revising vocational education programs are therefore quite complex. Especially at the postsecondary level, a large number of steps go into the curriculum development process. In some instances, it takes a minimum of two years to implement a new program using these systems. In many cases the complexity of the process makes it nearly impossible to develop and implement a state-of-the-art program.

In order to improve programs, vocational education needs to move away from relying on task analyses and labor market surveys as methods for identifying needs for programs and program content. More comprehensive approaches to vocational education curriculum development are needed. These approaches must provide processes for acquiring a wide variety of data including forecasts of skill requirements. They must provide decision-making models that permit valid and effective use of this information in creating and revising vocational education programs. Some other needs are as follows:

- Techniques for monitoring the knowledge and skill content of jobs must become more sensitive to emerging skills. More extensive and effective use should be made of on-site interviews with employees and their supervisors. Vocational education evaluation follow-up studies should include questions designed to acquire information on emerging skills and trends in job content.

- Delphi studies should be conducted at national and regional levels to project the implications of new research developments and new technology for the work place.

- Incentives should be provided to encourage efforts by vocational educators to identify new developments in technology and the implications of those developments for vocational education programs. Resources should be made available to assist teachers' efforts, including the latest technical literature and inservice training programs.

- Vocational education program and curriculum development processes must become more flexible and efficient. The planning and initiation of short-term, specialized programs related to new technology must become a reality.

Research

Educators need to determine the types of data that are most sensitive to and accurately predict emerging skills. Studies need to be conducted with a variety of data to determine their usefulness under various conditions.

Vocational education curriculum development systems that make effective use of historical, current, and future-based data need to be developed, tested, and disseminated.

Various studies need to be done on the type of analysis unit that should be used to analyze jobs to identify elements upon which instruction can be based. The task has served as a useful analysis element. However, tasks are usually defined in relation to a specific job and are not

readily transferable. The connecting links between occupational skills also need to be investigated.

There is a need to identify more specifically the environment and conditions that encourage and nurture the identification of emerging skills and their infusion into vocational education programs. Research in this area would make a valuable contribution to the knowledge available about the vocational education curriculum development process.

A research approach that appears to have potential for assessing the importance of emerging skills is the technology assessment center (Halfin, Melick, and Nelson 1981). This center would experiment with new technology and assess its relevance and importance for vocational education. Suggestions for introducing the technology into vocational education curricula would be developed by the center staff. These suggestions would include equipment lists and teacher and student materials.

Teacher Education

Vocational educators are the key to keeping vocational education programs current with the knowledge, skills, and systems employed in industry. Their continued quest to keep up to date with new and developing technology in their fields and their willingness to change are essential to relevant vocational education programs.

Teacher education programs at the preservice level must develop the following characteristics in vocational educators.

- Professional concern and motivation to keep current with new technology.
- Capacity to assimilate new knowledge and skills and infuse them into existing courses.
- Ability to use one or more futuristic techniques for forecasting future events. (The Delphi technique would be an appropriate basic technique in this area.)
- Skill in interviewing employees and supervisors to identify new technology and skills.
- Knowledge of how a new technology develops and is transferred into practice.
- Capability to identify and monitor trends in technology related to one's field.
- Ability to use evaluation and follow-up data to identify new skills.

Inservice education programs should provide vocational educators an opportunity to develop the following knowledge, skills, and attitudes.

- Professional curiosity
- Knowledge of current trends in technology and management procedures in business and industry
- Skill in monitoring changes in technology

- Ability to use evaluation and follow-up data and advisory committee input to identify emerging skills
- Capacity to use the Delphi and DACUM processes and various survey techniques to identify emerging skills
- Ability to construct questions, conduct interviews, and analyze interview data related to the technology used in business and industry
- Ability to use various types of data in developing curricula
- Knowledge of ways of using computers to locate and retrieve data from a data bank or library

Summary

The final two decades of the twentieth century will bring significant changes in the technology, processes, and skills used in business and industry. Vocational educators must be sensitive to and involved with these changes. Should they fail to monitor emerging skills and translate them into vocational education curricula, vocational programs will quickly become outdated.

APPENDIX

APPENDIX

SELECTED STUDIES UTILIZING PROCESSES FOR IDENTIFYING EMERGING SKILLS

A Feasibility Study for Solar Technology. Waco, TX: Texas State Technical Institute, April 1978.

Vocational Field: Trade and Industrial Education.
Sample: Ninety-nine businesses currently involved in the solar industry.
Procedure Used: Survey.
New Skills and Trends Identified: The potential for job growth in the solar energy field is noted. The areas of computer science, chemistry, mechanical technology, and solar technology are identified as important skill areas.

Arora, Mehar. *Evaluation of Vocational, Technical and Adult Education in Wisconsin: Delphi Conference.* Menomonie, WI: Center for Vocational, Technical and Adult Education, University of Wisconsin-Stout, 1974.

Vocational Field: Vocational Education.
Sample: Delphi panel members selected from vocational education, business, industry, government, and agriculture.
Procedure Used: Delphi process.
New Skills and Trends Identified: Predicts a number of trends related to vocational education. The trends toward small cars, home computers, videotaping systems, multiple family dwellings, do-it-yourself repairs, and automated manufacturing are forecast. The importance and impact of each trend for vocational education are also predicted. Specific emerging skills are not predicted because that was not one of the objectives of the study. However, implications for new skills are readily apparent.

Bauer, Dennis. "New Dimensions for Office Reprographics." *Business Education Forum*, November 1975, pp. 16 & 19.

Vocational Field: Business Education.
Sample: No information.
Procedure Used: Logical analysis of trends.
New Skills and Trends Identified: New skills identified are related to the operation of offset presses, special and automatic typewriters, copiers, and multiple column layout.

Cannon, Francis R.; Armstrong, Gary; and Armstrong, Ruth. *A Study to Determine the Skills and Knowledges Required for Personnel in Business Data Processing Centers: To Develop a Relevant Curriculum for Secondary Data Processing Programs and for Data Processing Programs in Teacher Education.* Shippensburg, PA: Shippensburg State College, 1978.

Vocational Field: Data Processing.
Sample: Pennsylvania businesses (1,851 from which 453 usable responses were obtained).
Procedure Used: Labor market survey.
New Skills and Trends Identified: Primarily identified trends in jobs in the business data processing area. Some skill areas identified for more emphasis are remote key entry of data, systems analysis, programming applications, and communications.

Changing Workforce Needs With Implications for Higher Education. Kenosha, WI: Gateway Technical Institute, 1978.

Vocational Field: Vocational Education.
Sample: Representatives from business, industry, and education.
Procedure Used: Symposium.

New Skills and Trends Identified: Presenters and discussion groups identified a variety of skills that will take on more importance in the years ahead. Increased involvement of employees in decision making will require more comprehensive knowledge of how business enterprises function and more sophisticated decision-making skills. The growing role of information in business will require improved ability to (1) analyze and use information, (2) solve problems, and (3) communicate the ideas and facts embedded in data. With the increasing rate of change, the capacity to change and adapt will be important.

Continuation of Futuring the Business Education Curriculum Needs. New York: Institute for Research and Development in Occupational Education, City University of New York, July 1978.

Vocational Field: Business Education.
Sample: Panel of experts.
Procedure Used: Conference.
New Skills and Trends Identified: Six papers on business education and projected job needs are reported. The papers focus on four main topics. Emerging skills are listed: time management, problem solving, operating videotape and playback devices, human relations skills, communications, economics of industrial organizations, and career decision making.

Dale, Dorothy; Klitzke, Elizabeth; Larson, Charlene; and Gertner, Betty. *Third Annual Composite Report for Secondary Vocational Education in Wisconsin: 1979-80.* Menomonie, WI: Center for Vocational, Technical and Adult Education, University of Wisconsin-Stout, 1980.

Vocational Field: Vocational Education.
Sample: Fifty-six secondary schools in Wisconsin.
Procedure Used: Evaluation study.
New Skills and Trends Identified: Employer and graduate follow-up data indicated satisfaction with the education and training provided by vocational programs. No specific data were collected on emerging skills. Many employers noted the need for more leadership training. Advisory committee members indicated that they believed they had contributed to curriculum development and the identification of specific tasks.

Elliott, William, "Role and Responsibility of Industry in the Professional Development of Vocational Educators." A paper presented at the 1978 Technical Assistance Conference, April 1978, Columbus, Ohio.

Vocational Field: Vocational Education.
Sample: No information.
Procedure Used: Review of related programs.
New Skills and Trends Identified: The need for administrative structures and processes for industry to utilize in educating vocational education teachers is described along with the need for staff development mechanisms to keep pace with changes in technology.

Halverson, Homer, et al. *Job Opportunities Forecast for Washington State, 1974 to 1985.* Olympia WA: Washington State Commission for Vocational Education, 1978.

Vocational Field: Vocational Education.
Sample: Task force with data inputs from an employment security office, U.S. Bureau of Labor Statistics, and other government departments.
Procedure Used: Labor market survey.
New Skills and Trends Identified: Findings are listed in terms of job growth and emerging occupations.

Hogue, Ken. *Identification and Analysis of Emerging Occupations in Marketing and Distributive Educational Final Report.* College Station, PA: Texas A&M University, July 1979.

Vocational Field: Marketing and Distributive Education.
Sample: Businesspersons (397) and distributive education coordinators (318) in Texas.
Procedure Used: Special survey: Two survey forms were used to collect job information.
New Skills and Trends Identified: Emerging jobs identified included travel agents, foreign exchange clerk, inventory control assistant, and pharmacy sales. A task analysis process was presented for use in identifying specific skills required in these jobs.

Identification of New and Emerging Careers or Occupations in West Virginia and Determination of the Feasibility of Providing Vocational Education Programs. Pittsburgh, PA: Associated Educational Consultants, 1979.

Vocational Field: Vocational Education.
Sample: Two task forces provided input. One was made up of specialists from the employment demand area and the second was composed of persons who had knowledge of vocational education programs.
Procedure Used: The task forces and an employer survey were used to provide projections of job openings.
New Skills and Trends Identified: The project identified policy issues, projected changes in occupations, and a planning process for new and emerging occupations. Some of the emerging occupations identified were coal conversion technologist, communications specialist, health equipment technician, recreation equipment repair specialist, and solar technician.

Inman, Thomas H., and Van Hook, Barry. "Internal Communication Essential for Effective Organization Management." *Business Education Forum*, February 1981, pp. 19-25.

Vocational Field: Business Education.
Sample: No information.
Procedure Used: Logical analysis of information available in business and industry.
New Skills and Trends Identified: The need for new and expanded skills in the areas of communication, leadership, interpersonal relationships, and self-concept is noted.

Johnson, Charles E. *A Comparative Analysis of Three Basic Designs for Competency Validation.* Athens, GA: University of Georgia, January 1977.

Vocational Field: Vocational Education.
Sample: On-the-job workers.
Pocedure Used: Task analysis, product assessment, and logical analysis.
New Skills and Trends Identified: The researcher concluded that each process is useful and that in some instances there is value in using the three in combination. Logical analysis was described as the most effective method for identifying changing competencies and those that are based on values, attitudes, and concepts.

Kaufman, Jacob J. *Human Resource Development and Vocational Education.* College Station, PA: Pennsylvania State University, May 1975.

Vocational Field: Vocational Education.
Sample: No information.
Procedure Used: Synthesis of the author's research acitivites in vocational education.
New Skills and Trends Identified: The study suggests that new skills workers need to develop include (1) the ability to learn new skills, (2) the capacity to accept more responsibility, (3) flexibility, and (4) improved capacity to make decisions.

Lesch, Gerald. "A Welding Survey of the Blackhawk Technical Institute Industries." Education specialist's thesis, University of Wisconsin-Stout, 1975.

Vocational Field: Trade and Industrial Education.
Sample: A sample of employers and employees in South Central Wisconsin.
Procedure Used: Task analysis with projections for five years.
New Skills and Trends Identified: The study reports that the use of several welding processes are predicted to increase, for example, plasma arc cutting and welding.

Maxwell, G.W. "Changes: Will They Never Cease?" *Journal of Business Education*, November 1980, pp. 44-46.

Vocational Field: Business Education.
Sample: No information.
Procedure Used: Logical analysis of current events and data.
New Skills and Trends Identified: Changes in population, society, families, and jobs were forecast. The average age of the work force will increase, and more married women will be employed. The trend toward the need for more white collar workers and clerical workers will continue. These changes will have a definite impact on the skills and knowledge needed in business and office jobs. Recommended is more emphasis on work experience, simulation, and gaming.

Maxwell, G.W., and West, Linda. *Handbook for Developing Competency Based Curricula for New and Emerging Occupations.* San Jose, CA: San Jose State University, 1980.

Vocational Field: Vocational Education.
Sample: An advisory committee comprised of vocational education teachers, coordinators, and administrators and a pilot-test committee that included vocational education teachers from high school and community college districts.
Procedure Used: Review of existing systems, interviews, and evaluation by the advisory and pilot-test committees.
New Skills and Trends Identified: A handbook was designed to assist vocational educators in preparing competency-based curricula for new and emerging occupations. Techniques for identiyfing new and emerging occupations, conducting task analysis, and developing competency-based curricula are discussed.

Meleen, Paulette, et al. *Identifying and Planning for New and Emerging Occupations: A Suggested Guide.* Belmont, MA: March 1976.

Vocational Field: Vocational Education.
Sample: National statistics.
Procedure Used: Analysis of legislation, technological changes, occupational trends, and societal changes.
New Skills and Trends Identified: The project developed a process for reviewing trends and changes in legislation, technology, society, and jobs to identify new and emerging occupations. New and emerging occupations identified in the study are: child advocate, energy efficiency technician, halfway house resident manager, horticultural therapy aide, industrial hygiene technician, nuclear quality assurance inspector, physical security technician, podiatric assistant, crystal manufacturing worker, housing rehabilitation specialist, and public safety communications operator.

Morton, J.B., et al. *Student and Employer Evaluation.* Stillwater, OK: State Department of Vocational, Technical and Adult Education—Research Division, 1977.

Vocational Field: Vocational Education.
Sample: Graduates (1,215) of secondary vocational and technical programs in Oklahoma and 106 of their employers.

Procedure Used: Evaluation survey questionnaire.
New Skills and Trends Identified: The relevance of the skills taught in vocational education programs was highly rated by graduates and employers. The knowledge of teachers, quality of equipment, and employer satisfaction with training of the graduates were rated. Graduates did not have an opportunity to identify new or obsolete skills and equipment. Employers were given an opportunity to list reason(s) for dissatisfaction with graduates.

Nelson, Orville. *New and Emerging Occupations: A Process for Monitoring and Identifying the Impacts for Vocational and Technical Education.* Menomonie, WI: Center for Vocational, Technical and Adult Education, University of Wisconsin-Stout, 1980.
Vocational Field: Vocational Education.
Sample: No information.
Procedure Used: Logical analysis of previous research, data, and labor market trends.
New Skills and Trends Identified: This study presents a process for identifying new occupations. In order to detect new and emerging occupations, changes and trends in technology, resources, life-styles, demography, and legislation must be continuously monitored. These changes and trends need to be analyzed to determine the implications for new jobs. Techniques used to study the future, such as the Delphi and scenario processes, should be used to forecast trends in technology. Follow-up studies of graduates and their employers may signal emerging needs. The procedure recommended is for vocational educators to gather, analyze, and interpret data; decide if a program is needed; write a job description; develop and validate a job task list; and then add this input to the regular curriculum development process. A lower risk approach is to develop units or courses based on the emerging skill(s) and use them in existing programs.

Norton, Robert E. et al. *The Identification and National Verification of Competencies Important to Secondary and Post-Secondary Administration of Vocational Education Final Report: Development of Competency-Based Instructional Materials for Local Vocational Education Administrators—Part I.* Columbus, OH: The Center for Vocational Education, The Ohio State University, 1977.
Vocational Field: Vocational and Technical Education.
Sample: Administrators (130)—a stratified national sample of secondary administrators and postsecondary vocational education programs. One hundred and twenty usable instruments were returned.
Procedure Used: A review of the literature and an administrative task inventory were completed. A DACUM panel made up of twelve administrators from four states met for three days to analyze vocational education administrator tasks and identify related competencies.
New Skills and Trends Identified: Project staff found the DACUM approach to be valuable in identifying a number of tasks that were not found in the literature or identified in the task survey. The report recommended that the DACUM process be used periodically to ensure up-to-date information about tasks.

Reed, Lester W., Jr. *Occupational-Technical Program Need Assessment Model.* Austin, TX: University of Texas, 1979.
Vocational Field: Vocational and Technical Education.
Sample: Employers, students, and adults.
Procedure Used: Employer survey, student survey, and adult survey questionnaires.
New Skills and Trends Identified: Needs assessment was utilized for identifying present and projecting future human resources needs. The process, which is based on information theory, is designed to provide information at the program level and

encourages the use of a variety of data. These include: graduate placements, labor market statistics (national, state, and local), potential program enrollees, wage profiles, and cost/benefit ratios.

Smith, Harold T. "The Office of the Future: Impact of Business Education." *Business Education Forum*, March 1981, pp. 37-38..

Vocational Field: Business Education.

Sample: No information.

Procedure Used: Analysis of trends in technology.

New Skills and Trends Identified: This study predicts that intelligent machines (for example, computer-controlled robots) will simulate human problem solving in the future, that communications will be substituted for travel, and that secretaries will work at home and send their output via telephone to the office. Occupations will become more knowledge based and workers will need to be able to speak and understand the terminology of the new technologies. They will also need an understanding of how these technologies apply to their jobs.

Sorensen, Robert P. "Perceived Priorities and Achievements of Occupational Advisory Committee Functions in the Wisconsin VTAE System." Doctoral dissertation, University of Wisconsin-Madison, 1974.

Vocational Field: Vocational and Technical Education.

Sample: State directors, advisory committee members, administrators, and teachers in vocational education.

Procedure Used: Q-Sort.

New Skills and Trends Identified: Participants in the study identified (1) the determination of program content, (2) the identification of community vocational education needs, and (3) the identification of equipment needs as three of the most important functions of advisory committees. Identification of emerging skills was not listed specifically but was implicit in the high priority tasks.

Stuart, Stephen L. *An Exploratory Study to Analyze New Skill Content in Selected Occupations in Michigan and the Mechanism for Its Translation into Vocational Education Curricula.* Columbus, OH: Battelle Columbus Laboratories, 1972.

Vocational Field: Vocational Education.

Sample: Advisory committees with representatives from labor, management, and vocational education. Employers were also interviewed.

Procedure Used: Advisory committees helped to construct task lists for selected occupations. These tasks were verified through employer interviews. The verified lists were then compared with the competencies developed by vocational education programs related to these areas.

New Skills and Trends Identified: The process disclosed programs with varied levels of irrelevant content. Some of these programs were almost completely out of date. For some tasks, the skills developed in the related vocational education program did not meet industry standards. The model presented for identifying emerging skills includes task analyses, employer and graduate feedback, discrepancy analyses contrasting task analysis results with program content, and specification of objectives in behavioral terms.

Van Ausdle, Steven, ed. *Vocational Education's Role in a Changing Economy.* Olympia, WA: Washington Department of Public Instruction and State Board for Community College Education, April 1978.

Vocational Field: Vocational and Technical Education.
Sample: Symposium of representatives from business, industry, labor, agriculture, government, and education.
Procedure Used: Symposium.
New Skills and Trends Identified: Economists from education and industry noted the problems in predicting economic trends. If forecasts are to be made, they should be developed frequently. The need to improve productivity and the increasing use of electronics in a variety of jobs were discussed.

Wakin, B. Bertha. "Business Dynamics: A New Direction for a New Decade." *Business Education Forum*, February 1981, pp. 11-12.
Vocational Field: Business Education.
Sample: Committee of business executives, educators, and national experts.
Procedure Used: A comprehensive study of businesses in New York and a symposium in which the results of the study were discussed.
New Skills and Trends Identified: The study identified the need for (1) improved decision making, human relations, and problem-solving skills, (2) a more comprehensive knowledge of our economic system, and (3) knowledge of basic computer applications.

Wallbrown, Rodney. "Keeping Up to Date—A Must for Vo-Ag." *The Agricultural Education Magazine*, March 1981, pp. 5-6.
Vocational Field: Vocational Agriculture.
Sample: No information.
Procedure Used: Analysis of changes in agriculture.
New Skills and Trends Identified: The need to monitor literature, demonstrations, and applications of new practices, equipment, and genetic techniques is noted in this article.

REFERENCES

Arora, Mehar. *Evaluation of Vocational, Technical and Adult Education in Wisconsin: Delphi Conference.* Menomonie, WI: Center for Vocational, Technical and Adult Education, University of Wisconsin-Stout, 1974.

Brill, Winston J. "Agricultural Microbiology." *Scientific American* 245 (September 1981): 198.

Burt, Samuel M. *Industry and Vocational-Technical Education.* New York: McGraw-Hill, 1967.

Cannon, Francis, R.; Armstrong, Gary; and Armstrong, Ruth. *A Study to Determine the Skills and Knowledges Required for Personnel in Business Data Processing Centers: To Develop a Relevant Curriculum for Secondary Data Processing Programs and for Data Processing Programs in Teacher Education.* Shippensburg, PA: Shippensburg State College, 1978.

Changing Workforce Needs With Implications for Higher Education. Kenosha, WI: Gateway Technical Institute, 1978.

Dale, Dorothy; Klitzke, Elizabeth; Larson, Charlene; and Gertner, Betty. *Third Annual Composite Report for Secondary Vocational Education in Wisconsin: 1979-80.* Menomonie, WI: Center for Vocational, Technical and Adult Education, University of Wisconsin-Stout, 1980.

Drucker, Peter F. "The Coming Changes in Our School System." *The Wall Street Journal,* 3 March 1981.

Elliott, William. "Role and Responsibility of Industry in the Professional Development of Vocational Educators." A paper presented at the 1978 Technical Assistance Conference, April 1978, Columbus, Ohio.

Flax, Steven. "The Other Side of Agony." *Forbes* 126 (September 1980): 113, 115.

Flint, Jerry. "The Myth of the Lazy American." *Forbes* 128 (July 1981): 105-11.

Freeborne, Gerald. *Vocational Education in New York State. Hearings on the Reauthorization of the Vocational Education Act of 1963—Part I: Vocational Education in Different Institutional Settings.* Subcommittee on Elementary, Secondary, and Vocational Education of the Committee on Education and Labor, House of Representatives, February 24-25, 1981. Washington, DC: U.S. Government Printing Office, 1981.

Guest, Robert H. "Quality of Work Life—Learning from Tarrytown." *Harvard Business Review* 57 (July-August 1979): 76.

Halfin, Harold; Melick, Margaret; and Nelson, Orville. "Final Report of the Project of Evaluation of the Secondary Vocational Education Delivery System in Wisconsin." An unpublished report. Menomonie, WI: University of Wisconsin-Stout, 1981.

Halverson, Homer, et al. *Job Opportunities Forecast for Washington State, 1974 to 1985. Olympia, WA: Washington State Commission for Vocational Education, 1978.*

Hinrichs, John R. *Practical Management for Productivity.* New York: Van Nostrand Reinhold, 1978.

Hogue, Ken. *Identification and Analysis of Emerging Occupations in Marketing and Distributive Education Final Report.* College Station, PA: Texas A&M University, July 1979.

Identification of New and Emerging Careers or Occupations in West Virginia and Determination of the Feasibility of Providing Vocational Education Programs. Pittsburgh, PA: Associated Educational Consultants, 1979.

Johnson, Charles E. *A Comparative Analysis of Three Basic Designs for Competency Validation.* Athens, GA: University of Georgia, January 1977.

Lesch, Gerald. "A Welding Survey of the Blackhawk Technical Institute Industries." Education specialist's thesis, University of Wisconsin-Stout, 1975.

Maeroff, Gene I. "U.S. Study Assails Vocational Courses." *The New York Times,* 16 October 1979.

Malkiel, Burton G. "Productivity—The Problem Behind the Headlines." *Harvard Business Review* 57 (May-June 1979): 81-91.

Maxwell, G.W., and West, Linda. *Handbook for Developing Competency Based Curricula for New and Emerging Occupations.* San Jose, CA: San Jose State University, 1980.

Meleen, Paulette, et al. *Identifying and Planning for New and Emerging Occupations: A Suggested Guide.* Belmont, MA: March 1976.

Molitor, Graham T.T. "The Information Society: The Path to Post-Industrial Growth." *The Futurist* 15 (April 1981): 13-30.

Morton, J.B., et al. *Student and Employer Evaluation.* Stillwater, OK: State Department of Vocational, Technical and Adult Education—Research Division, 1977.

Nelson, Orville. *New and Emerging Occupations: A Process for Monitoring and Identifying the Impacts for Vocational and Technical Education.* Menomonie, WI: Center for Vocational, Technical and Adult Education, University of Wisconsin-Stout, 1980.

Report of the 1978 Annual Meeting of Stockholders. New York: Sperry Rand Corporation, 1978.

"Robots Join the Labor Force." *Business Week,* 9 June 1980, pp. 62-68.

Rose, Anthony H. "The Microbiological Production of Food and Drink." *Scientific American* 245 (September 1981): 126.

Sinnett, William E. *The Applications of DACUM in Retraining and Post-Secondary Curriculum Development.* 2nd rev. ed. Toronto: Humber College of Applied Arts and Technology, 1976.

Sloan, Allen, and Miles, Christine. "GM's Chance of a Lifetime." *Forbes* 126 (September 1980): 110-112.

Sorensen, Robert P. "Perceived Priorities and Achievements of Occupational Advisory Committee Functions in the Wisconsin VTAE System." Doctoral dissertation, University of Wisconsin-Madison, 1974.

Stuart, Stephen L. *An Exploratory Study to Analyze New Skill Content in Selected Occupations in Michigan and the Mechanism for Its Translation into Vocational Education Curricula.* Columbus, OH: Battelle Columbus Laboratories, 1972.

Toffler, Alvin. *The Third Wave.* New York: William Morrow, 1980.

Van Ausdle, Steven, ed. *Vocational Education's Role in a Changing Economy.* Olympia, WA: Washington Department of Public Instruction and State Board of Community College Education, April 1978.

Varney, Glenn H. "Productivity in the 80's—Are You Ready?" *Training and Development Journal* 18 (March 1981): 13-17.

Wakin, B. Bertha. "Business Dynamics: A New Direction for a New Decade." *Business Education Forum*, February 1981, pp. 11-12.